The HART to FF gateway,   the T700
Reference Manual

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<u>T</u>ABLE OF <u>F</u>IGURES

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About this document

The Reference Manual gives an overview of the capabilities and the use of the T700 DIN rail mounted generic Profibus DP gateway. Furthermore, it explains how to configure the device.

The following abbreviations are used in this document:

PV   Primary dynamic variable in the transmitter
SV   Secondary dynamic variable in the transmitter
TV   Third dynamic variable in the transmitter
FV   Fourth dynamic variable in the transmitter
DD   Device description
TB   Transducer Block
FB   Function Block
RB   Resource Block
NAMUR NE107   Standard for Field Diagnostics
PLC   Control or monitoring system
HOST   Control system

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Summary

The T700 capabilities can be summarized as follows:

- Interfaces up to four HART devices to Foundation Fieldbus
- Supports reading of an Additional Device in each HART instrument
- Powered from 18V – 30 V instrument power
- Support for NAMUR NE107 Diagnostics

The instrument interface:

Protocol:
- HART

Physical interfaces:
- HART sinking or sourcing devices

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1. HART TO FOUNDATION FIELDBUS - THE T700

1.1. Functional Description

The T700 is a FF compliant DIN rail mountable gateway for connecting HART instruments to FF. Applying the T700 enables legacy instruments with a HART interface to connect to a FF network.

Figure 1. The T700

Up to four HART instruments can be connected through one T700 module.

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Host system

Fieldbus

T700

HART

Instruments, max 4
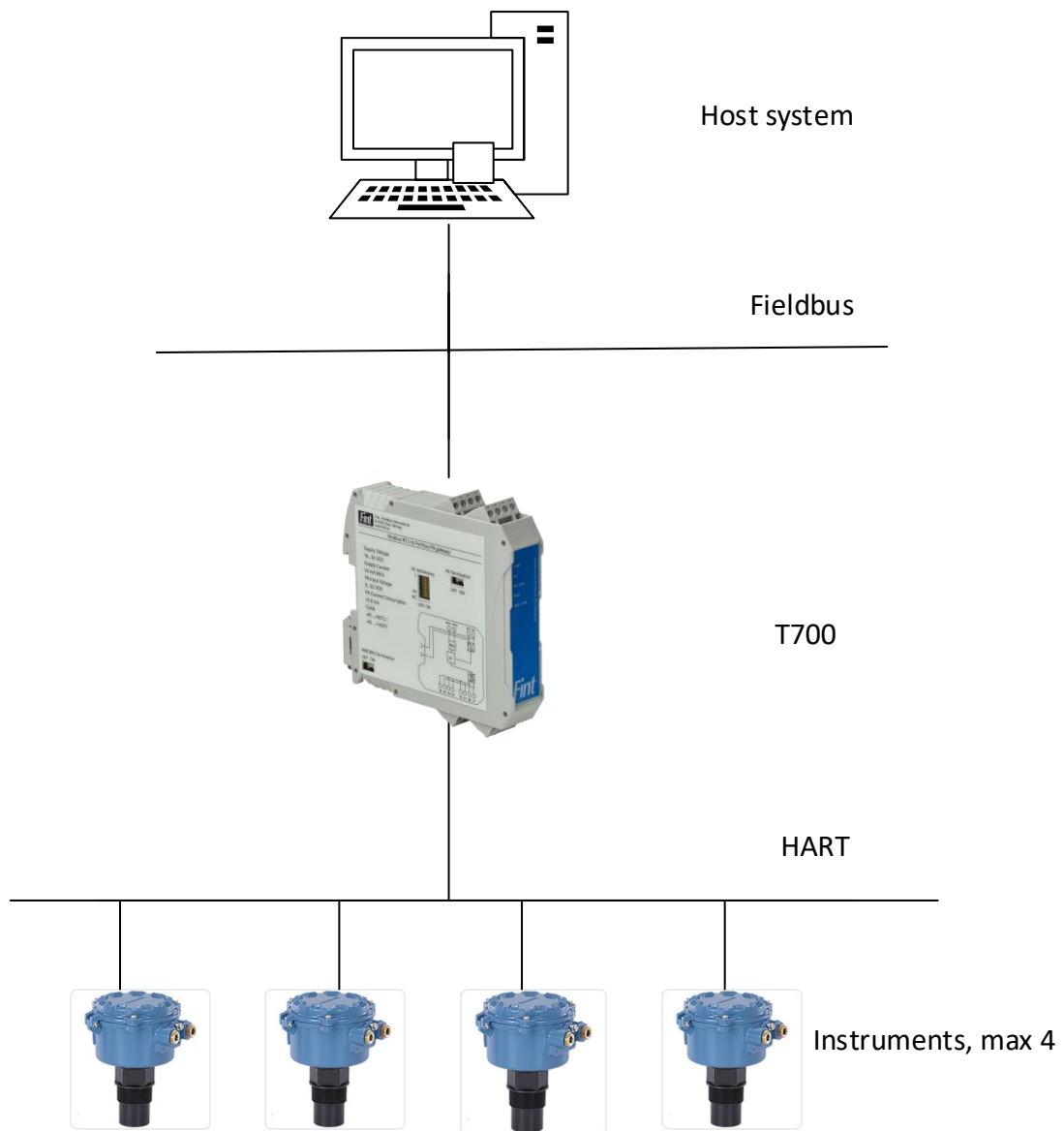
Figure 2. The T700 device in a typical application

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The T700 is intended for installation on a DIN rail and within a cabinet. It is powered from an 18 – 30 VDC supply

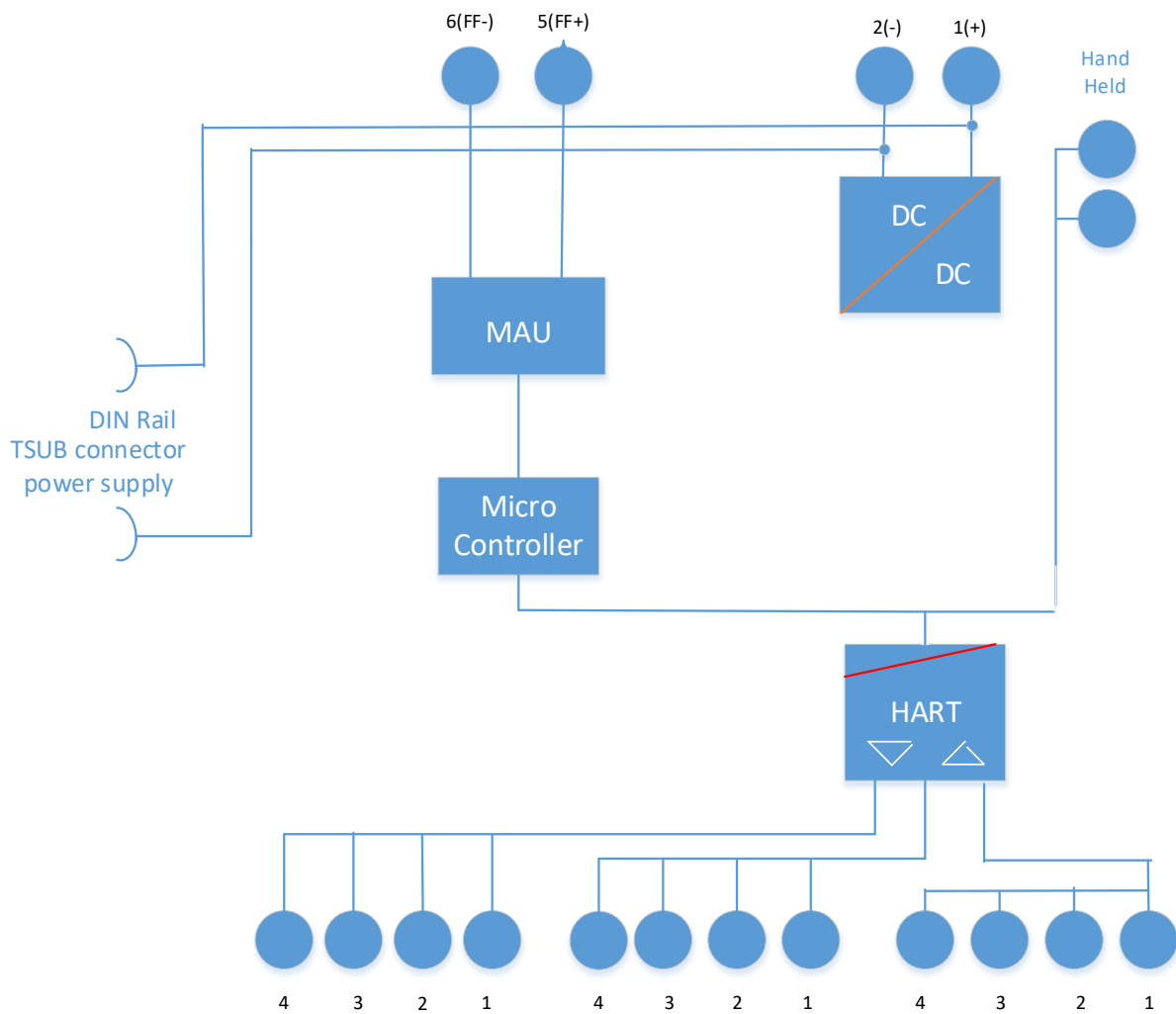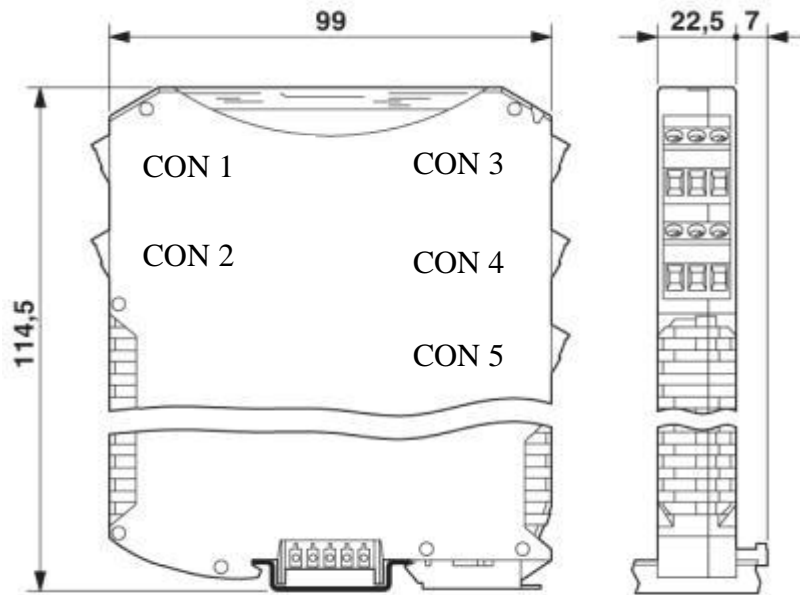**Figure 3. Functional Diagram**

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1.2.   Mechanical Dimensions

Figure 4. ME MAX Dimensions

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1.3. Installation

The T700 is designed for being mounted in a cabinet on a DIN rail.

1.3.1. Electrical Connections

The T700 contains 5 pluggable screw terminals.

The T700 shall use the screw terminal pinout as shown in Table 1:

Connector	Pin	Comment
CON 1	1	Positive supply to T700
	2	Negative supply to T700
PWR	3	No Connection
	4	No Connection
CON 2	1	FF +
	2	FF -
FF -	3	No Connection
	4	No Connection
CON 3	1	Channel 1 -
	2	Channel 2 -
HART Sourcing	3	Channel 3 -
Instruments	4	Channel 4 -
CON 4	1	Channel 1 Common
	2	Channel 2 Common
HART Common	3	Channel 3 Common
	4	Channel 4 Common
CON 5	1	Channel 1 +
	2	Channel 2 +
	3	Channel 3 +
HART Sinking Instrument	4	Channel 4 +
DIN clip	-	PE connection for EMC (see Figure 6)

Table 1: Connector Arrangement Table

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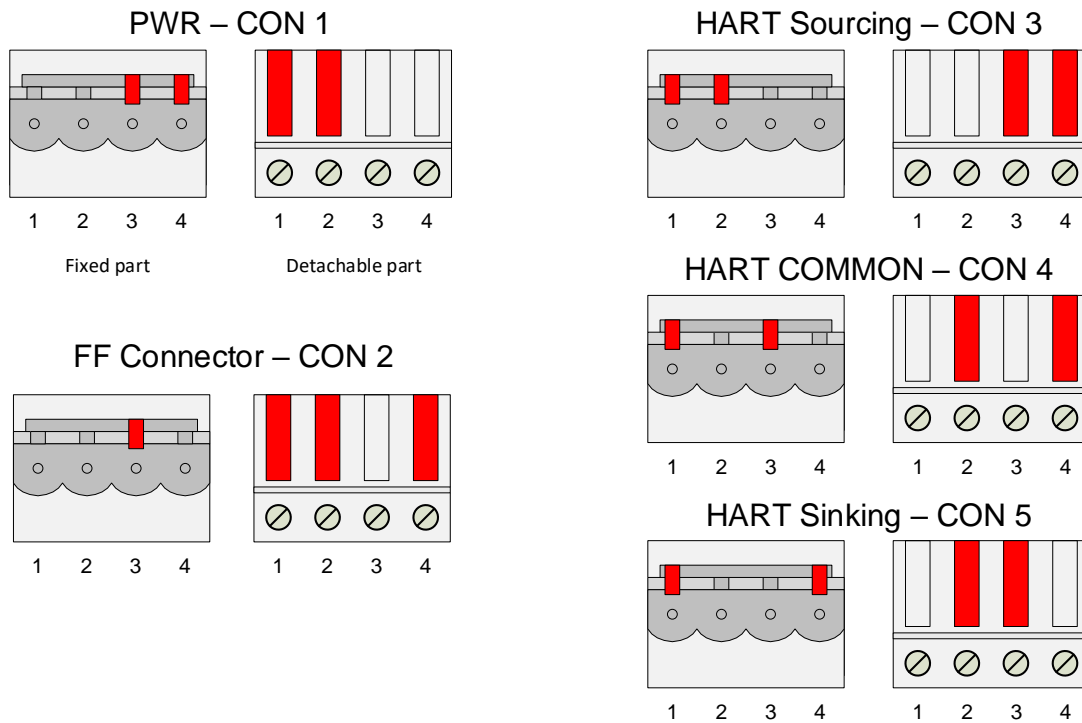The detachable plugs are coded to avoid misconnection.

Figure 5. Coding of the plugs

1.3.2. Slide switches and DIP switches

1.3.2.1.   FF termination

The Fieldbus lines may be terminated in the T700. Whether to terminate is selected by a slide switch as indicated in Figure 6.

1.3.2.2.   DIP switches

Write protect and Simulation jumper are available on the DIP switches as indicated in Figure 6.

1.3.2.3.   Programming utility

Behind the panel on top of the device there is a USB connector for updating software in the field.
See Figure 6.

1.3.2.4.   Configuration utility

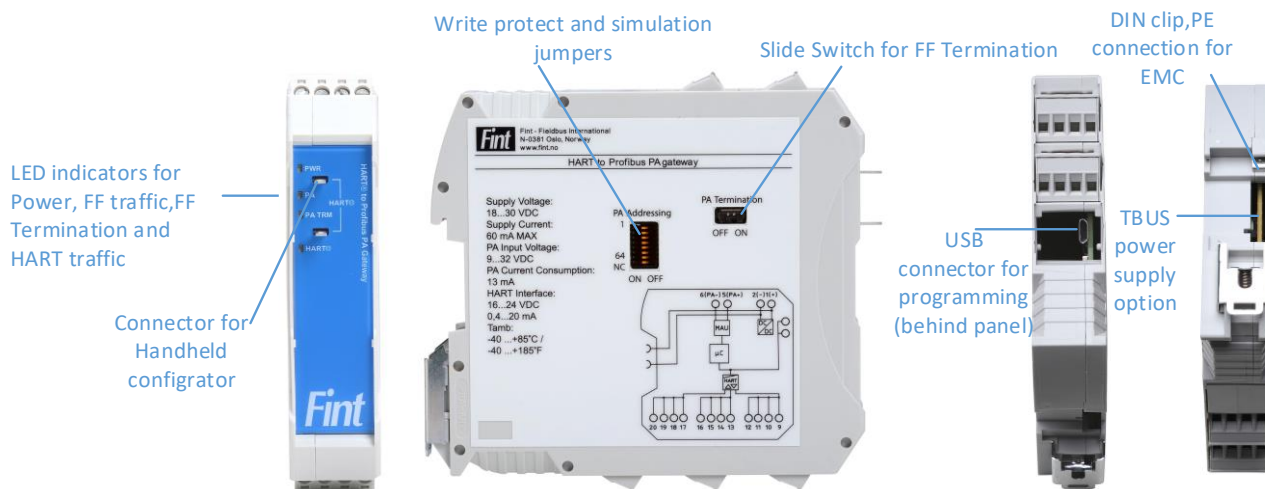On the front panel there is a connector for a Handheld configurator.

Figure 6. Front and Side Label mounted on T700, showing the functions

1.3.3. Power, Termination and Diagnostic LEDs

There are four LEDs on the front. One for Power ON, one for FF Termination ON/OFF, one for the
HART communication and one for the FF communication. The communication LEDs are bicolor.
One color is blinking on request telegrams and the other on responding telegrams. A slow blink in
one of the HART LED indicates that there is no HART communication.

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2.   CONNECTING A **HART** TRANSMITTER TO **T700**

Current sinking and sourcing HART devices can be connected, but needs to connected in different ways. Current sinking and sourcing devices can be combined on the same T700.

2.1. Current Sourcing devices

Current sourcing instruments shall be connected to T700 in following manner:

Figure 7. Connecting Current Sourcing HART Transmitters

NOTE!

The direction of the 4-20 mA loop current is important. Protecting diodes will block the loop current if connected in the opposite direction.

NOTE!

Don't use external resistors in the HART loop. A HART resistor is built into the T700.

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2.2. Current sinking devices

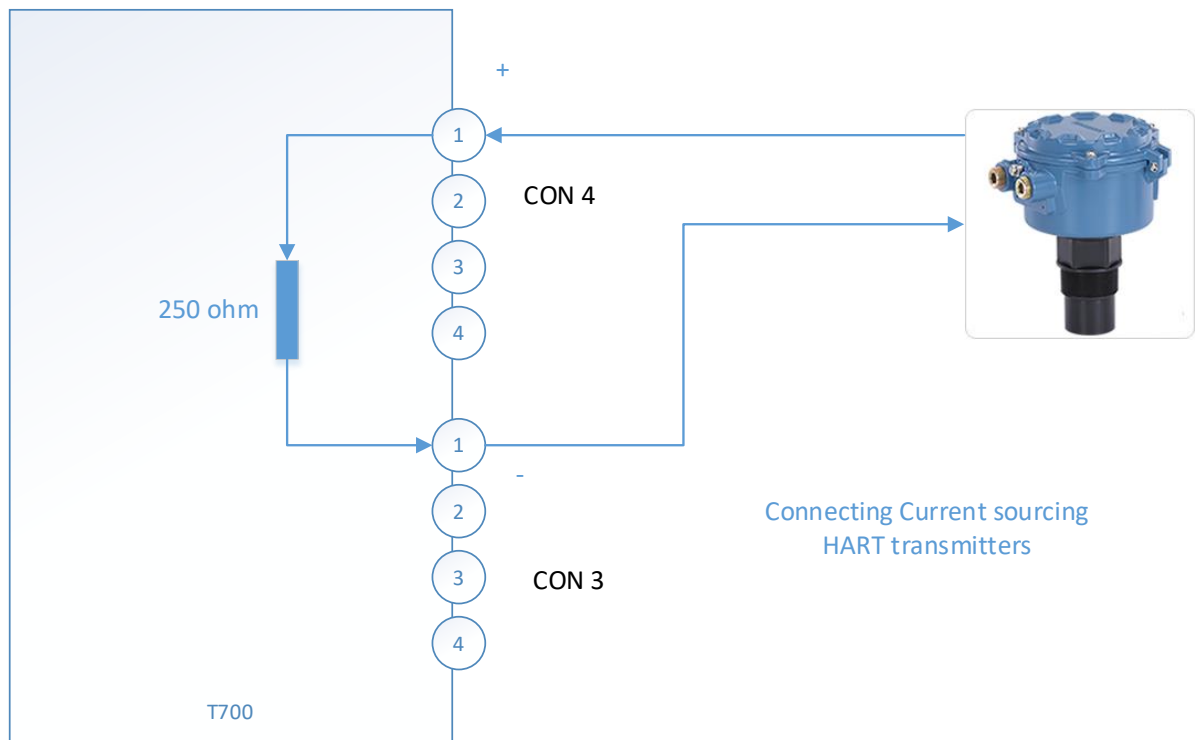Current sinking devices takes their loop current from the T700.
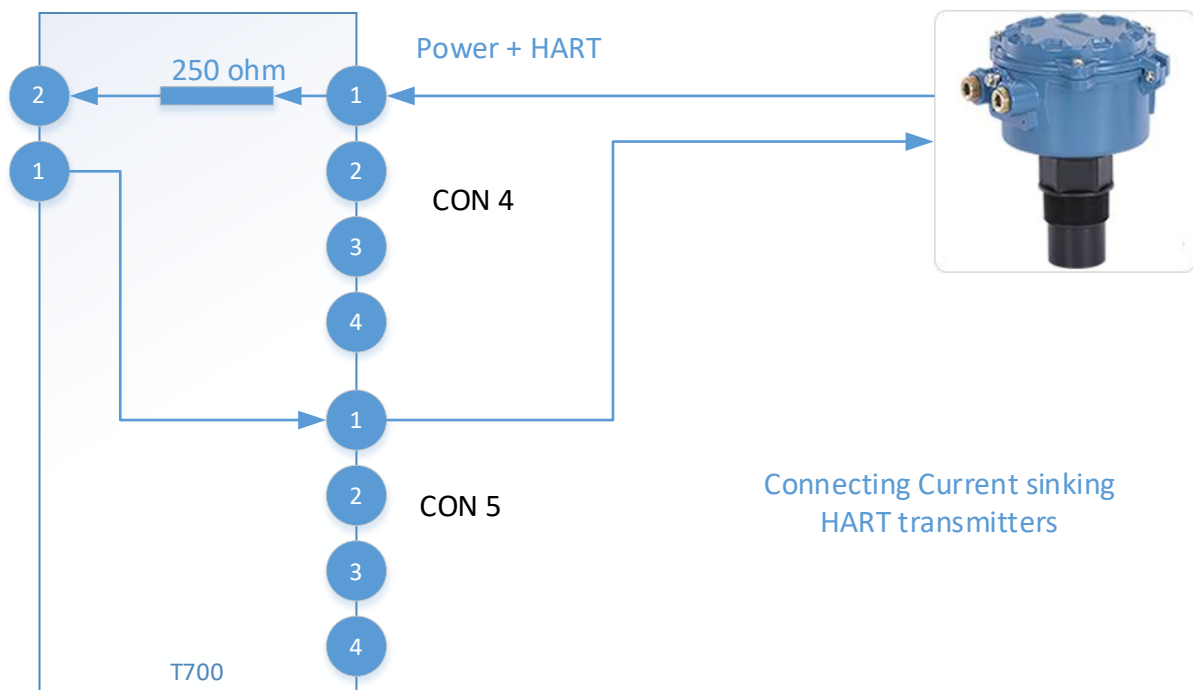

Figure 8. Connecting Current Sinking HART Transmitters

NOTE!

The direction of the 4-20 mA loop current is important. Protecting diodes will block the loop current if connected in the opposite direction.

NOTE!

Don't use external resistors in the HART loop. A HART resistor is built into the T700

3.   OPERATION PRINCIPLE

3.1.   Connecting HART devices

The T700 is a protocol converter, to allow legacy HART devices to communicate on a FF network.

Up to four channels are supported. Each device sourcing channel is defined by a HART short Address. Up to four HART devices may be connected. This implies four different HART addresses. The HART instruments are electrically interconnected within T700.

Connecting procedure:

Set the HART instruments to a HART multi-drop address, 1- 16. This should preferably be done before connecting to the T700.

NOTE ! *The output from T700 is limited to 20 mA. If the loop current because the sinking HART transmitters draw more, the HART signals will be clipped and no communication will be possible.*

Arrange the addresses so that the output to the PLC is in the order wanted, with the lower HART address first.

On single HART devices with single-drop address 0 can be connected. It will be detected in the same manner as multi-drop HART devices. No special setting of the T700 will be required.

NOTE! *Single-drop and multi-drop devices cannot be mixed*.

Current sourcing HART devices shall be connected as in Figure 5

Current sinking HART devices shall be connected as in Figure 6

When the all HART devices are connected, run a scan. This can be done from a configuration program in the Host system.

The result of the scanning is reported as ok or fault in FF status.
See appendix A for possible scanning errors.

3.2. Variables

The T700 can support up to 4 HART transmitters. The Primary Value (PV) from each of these transmitters will be calculated in four channels through a Transducer Block (TB) and a Function

Block (FB). In the FBs there are Scaling, Damping and Alarm setting functions. These functions can be configured from the configuration tool in the Host system.
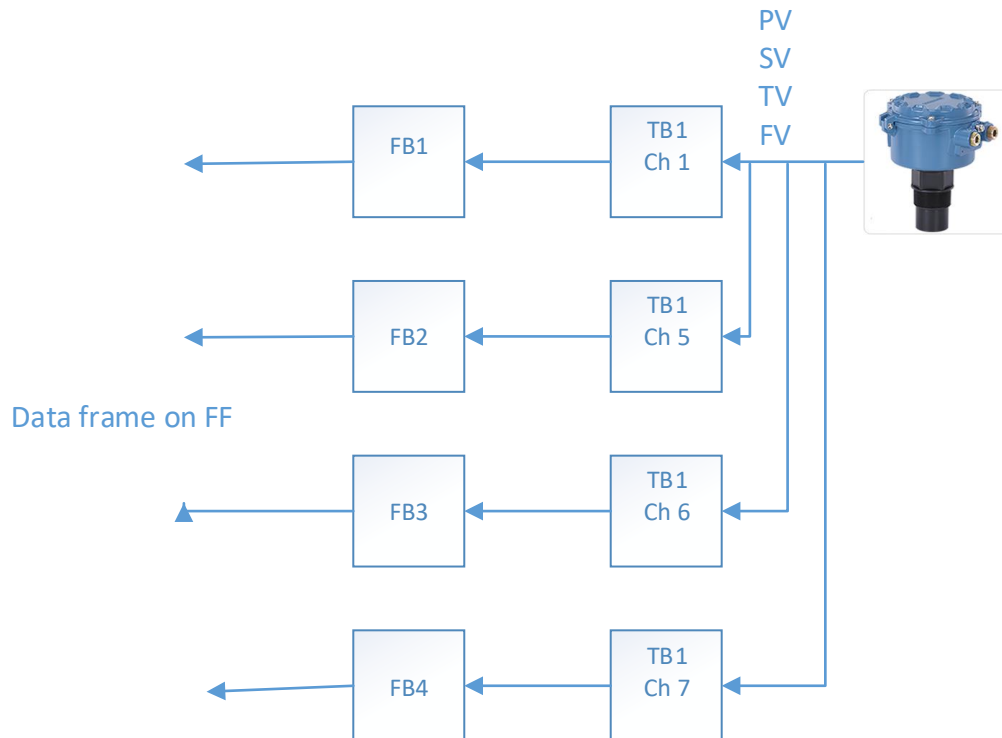

Figure 9. Four HART transmitters connected to T700

Using a configurator, it is possible to set-up the T700 read all dynamic variables from one HART transmitter instead of the PV from four different transmitters. See Figure 10.
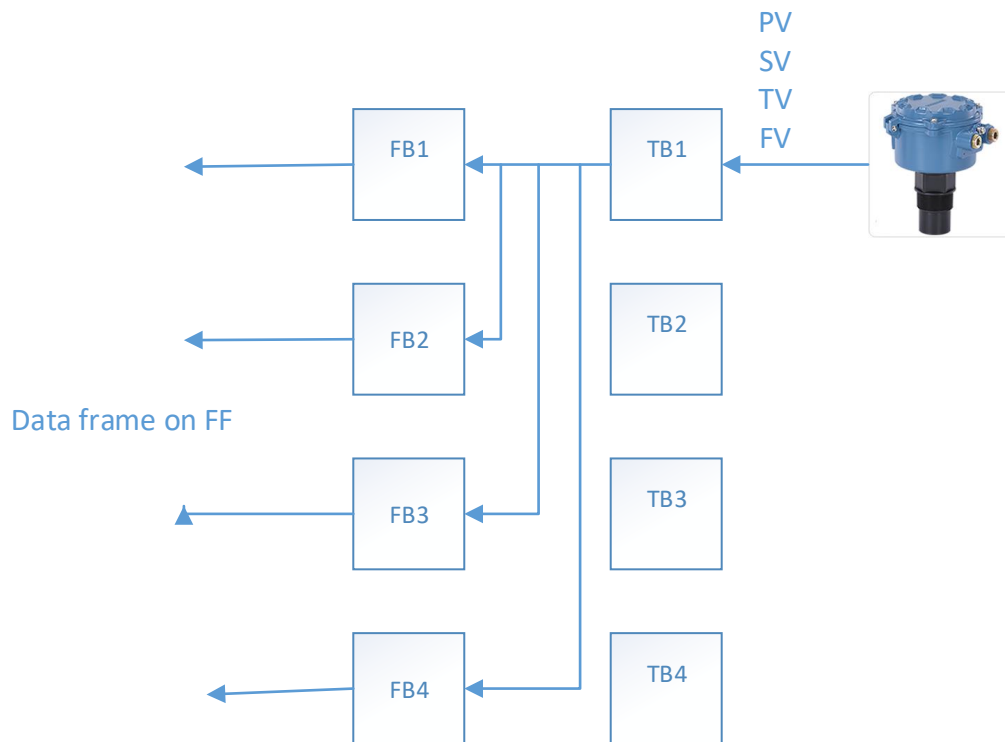
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Figure 10. One HART transmitter connected to T700

3.3. Diagnosis

3.3.1. Diagnosis information from the HART Instrument

The Diagnosis is gather in a 32 bit structure containing Diagnosis information from each instrument, status on the HART communication and whether the Scanning of HART instruments were successful or not.

The NAMUR NE107 Diagnosis structure contains:
- HART device NAMUR NE 107 diag flags
- HART Communication Errors
- HART Communication Warning
- Internal Fault in T700
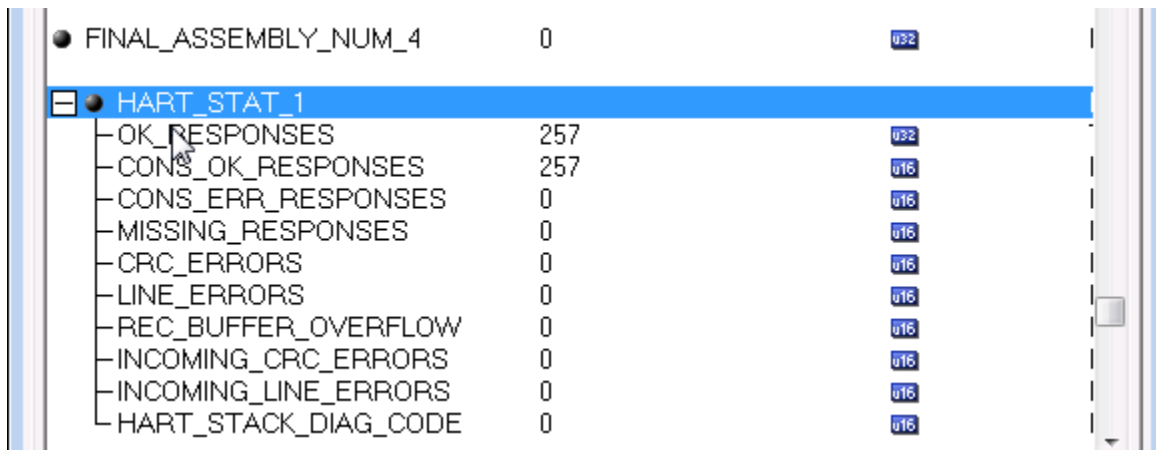- Scan error
- HART Additional Status

Using four 32 bit masks the user can select which of these flags shall be mapped to four NAMUR NE107 flags:

- Failure
- Out of Spec
- Function Check
- Maintenance required.

A configuration tool will be required for this operation.

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3.4. HART communication statistic

For each channel the HART communication is supervised. This information can help debug difficulties on a HART line. The HART Statistic window is shown in Figure 11

Figure 11. **HART statistics**

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4. CONFIGURATION

The following configuration needs to be done:

1. Scan HART network
2. Select channels

Scan HART network can be done using the configurator in any HOST system or the NI configurator.

Make sure the transducer block is set to OoS mode and then use the transducer block parameter HART_INSTRUMENT_SCAN to initiate a scanning of the Hart network by selecting the "Initializing HART scan" entry in the dropdown list. Is does not matter if other entries in the same dropdown list are selected at the same time.

The scan function will detect either one to four HART transmitters in muli-drop mode or one HART transmitter in loop current mode.

The scanning will go through address 0 up to 15. Only one device can be detected if it is located at address 0 (loop current mode). Up to four transmitters can be detected when they are configured to multidrop mode (loop current disabled).

NB! Be aware that the T700 cannot power feed more than one device with loop current enabled.

During a Hart scan up to four Hart instruments will be tried detected in the short address range 1-15 (multi-drop mode). It is important that each instrument is configured with a unique short address and that loop current mode is disabled (the latter is only relevant for transmitters of HART 6 or later revisions). The Dynamic variables (PVs) from the lower short address will be mapped into the lower Analog Input Function Block.

If only one Hart instrument shall be connected to the Hart network there is no need to use multi-drop mode. Instead the instrument can be detected by command 0 at short address 0.

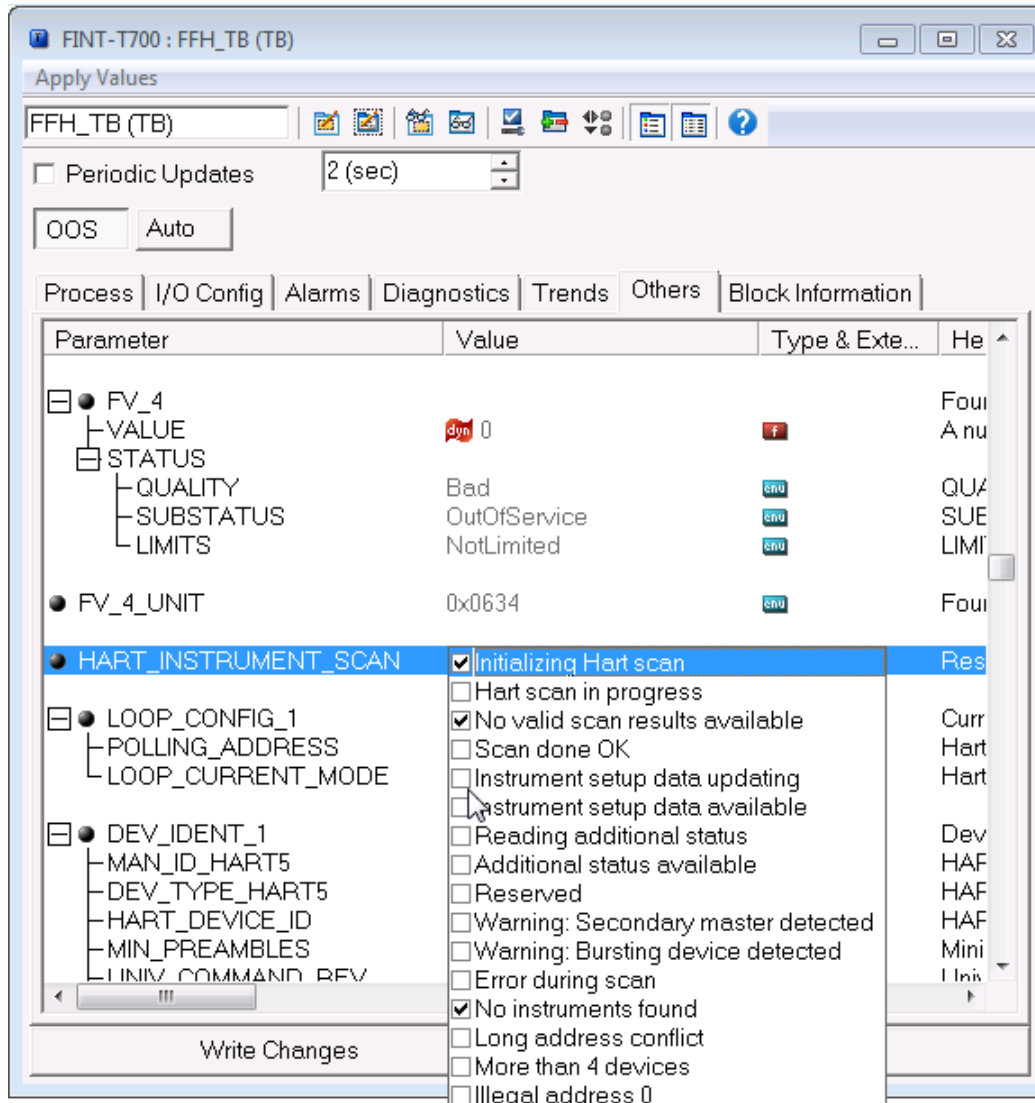When scanning is completed the T700 will load parameters from the connected HART transmitters.

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Figure 12. Starting a HART scan
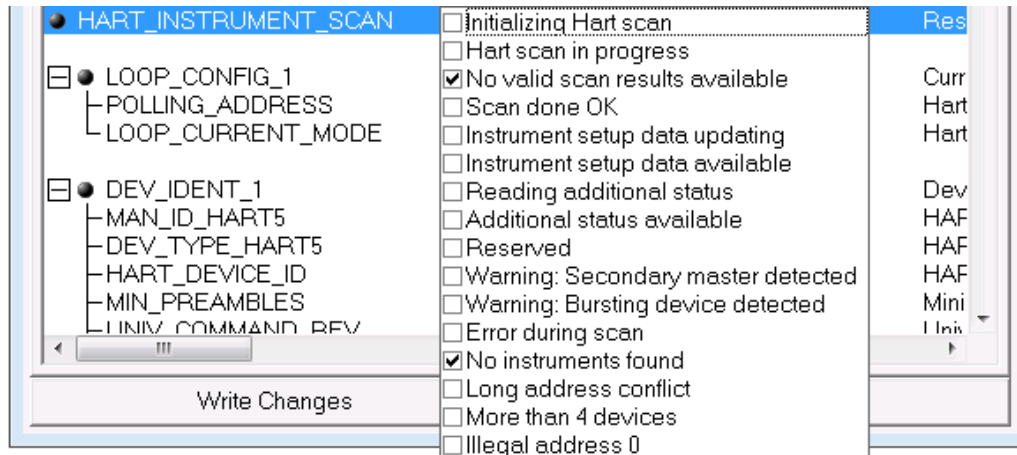
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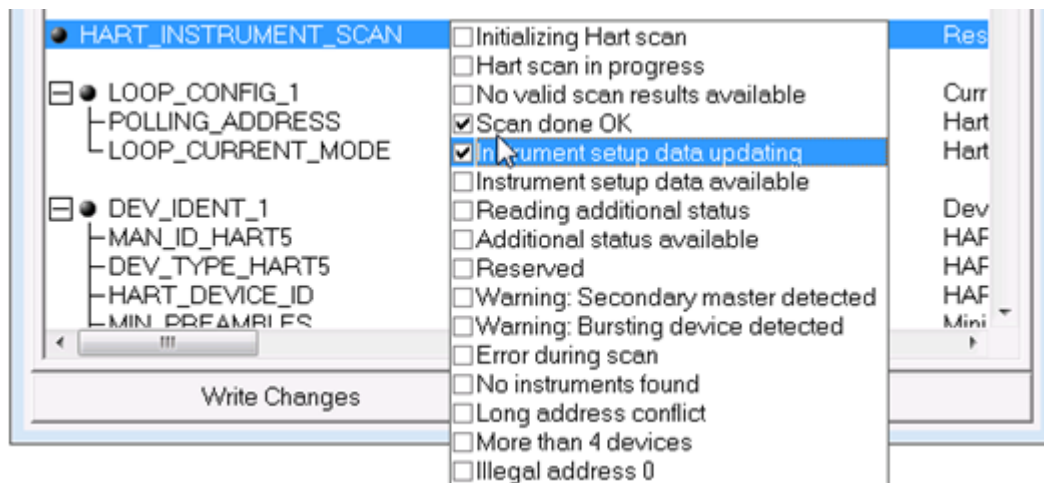**Figure 13. Scan Status when NO Hart instrument is connected**

Figure 14. Scan status after instrument(s) are detected

Figure 14 show the scan status after instrument(s) are detected and setup data is in the process of being read out of the HART instrument(s)
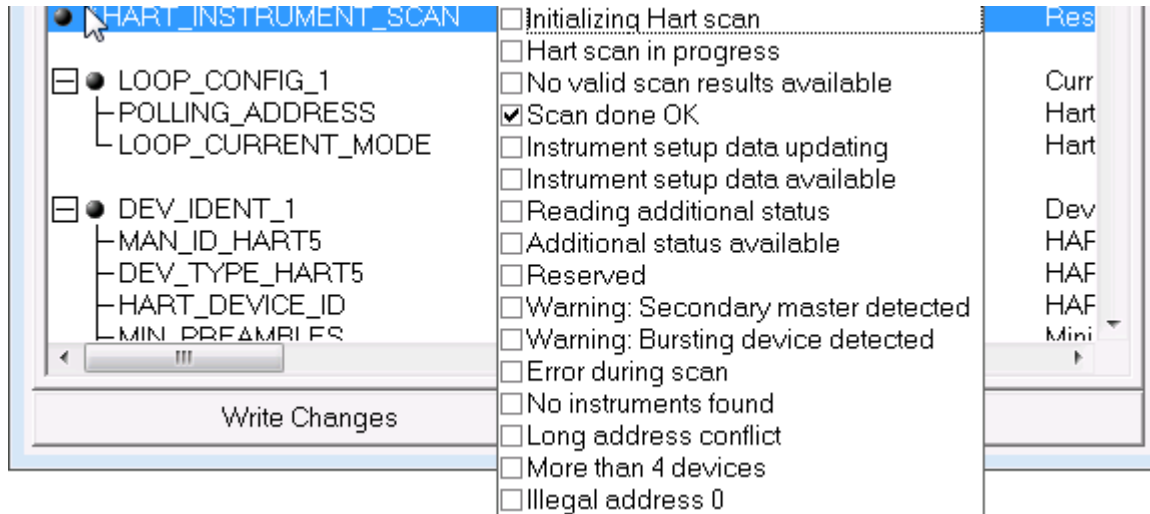
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Figure 15. Scan is finished and the result is Ok

Select channels can be done using the configurator in the Host. Default the PV from four separate HART transmitters channels are routed to the Cyclic-Data exchange frame. If more variables (SV, TV and FV) shall be read from one transmitter, the channels have to be reconfigured. See Figure 10.

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5. TECHNICAL SPECIFICATIONS

5.1. Technical specification T700

Mechanical:

Size	114,5 * 99 mm
Mounting	DIN rail
Module width	23,2 mm
Weight	192 gram
Housing	Plastic Polyamid, IP-20 protection
DIP Switch	Profibus address (1-125)
Slide Switch	FF Terminator

Electrical:

Supply voltage	18....30 VDC
Supply current	60 mA MAX
PA input voltage	9.....32 VDC
HART Interface	16..24 VDC, 0,4..20mA

Environmental:

Operating temperature range	-40 °C to + 85 °C
Shock	IEC 600068-2-27
Vibration resistance	IEC 600068-2-6

Protocols and Ports:

Protocol	FF
FF bus connector	Screw terminal

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6.   APPENDIX A: SCANNING FAULTS

If a Scan Error is reported, check the following:

- All HART instruments are connected properly, ref 2.2.
- One or more of the instruments have short address 0.
- More than 4 instruments are connected
- One or more instrument has the malfunction bit set in device status.

If an instrument is not detected and no Scan Error is reported, check that each connected instrument has a unique short address.